Dec. 18, 1962 C. I. TAYLOR 3,068,876

APPARATUS FOR CLEANING THE NOZZLE BODIES OF THE INJECTORS OF COMPRESSION IGNITION INTERNAL COMBUSTION ENGINES

Filed July 24, 1961 4 Sheets-Sheet 1

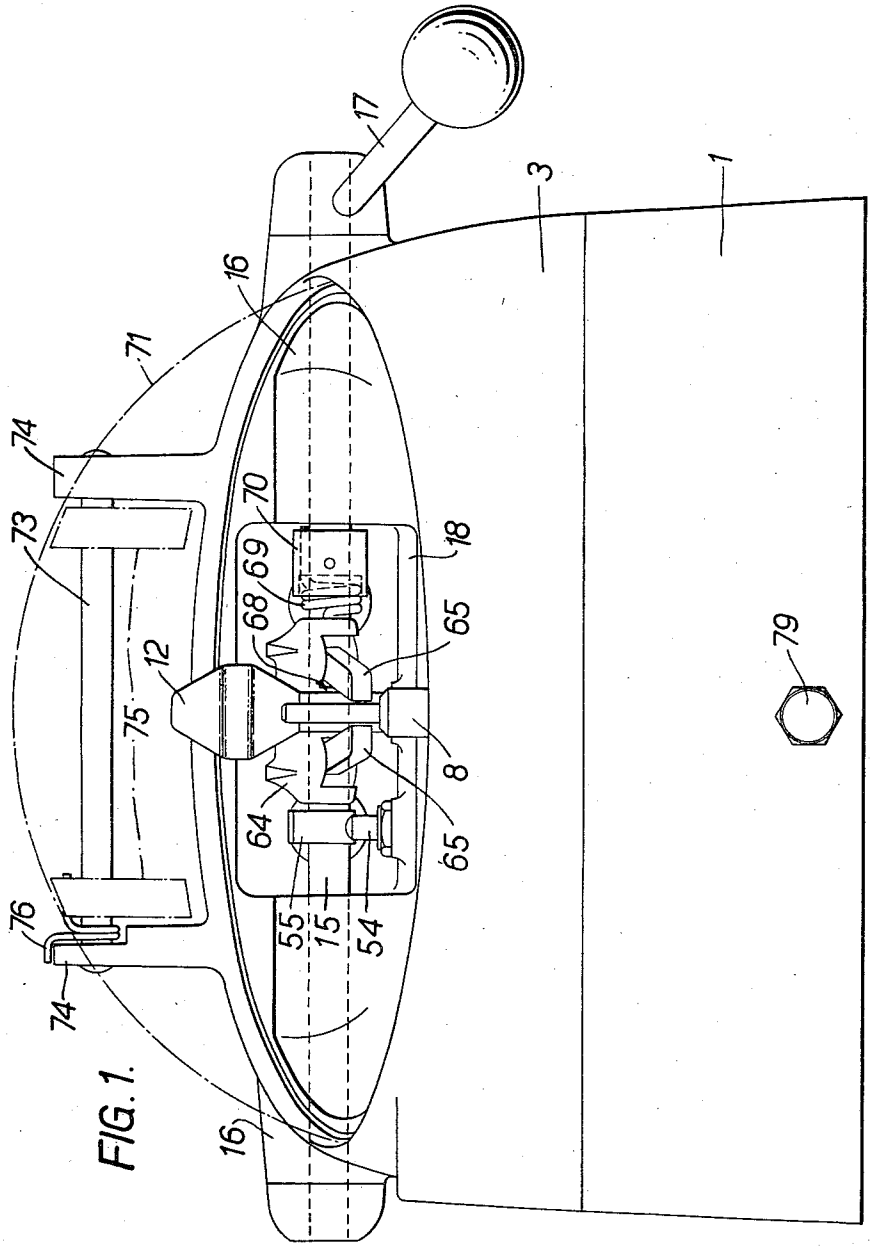


FIG. 1.

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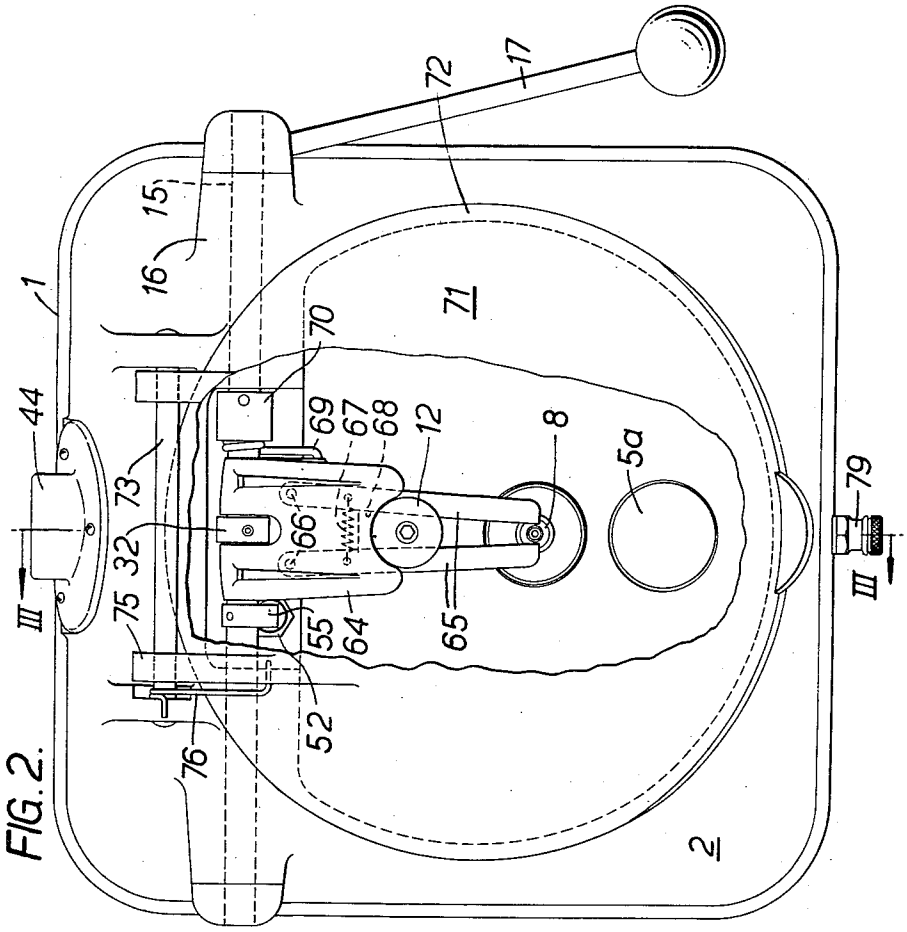


FIG. 2.

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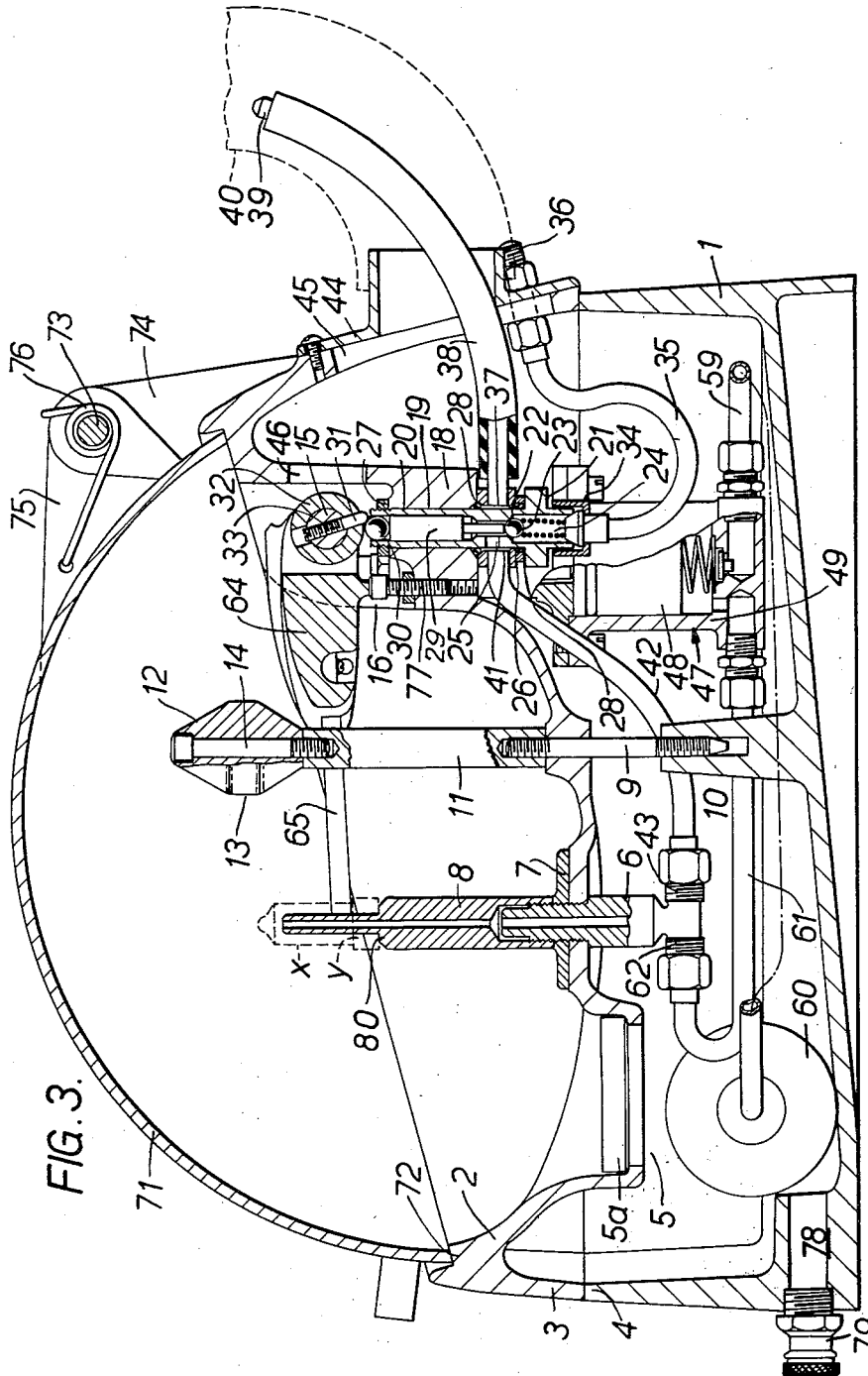


FIG. 3.

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APPARATUS FOR CLEANING THE NOZZLE BODIES OF THE INJECTORS OF COMPRESSION IGNITION INTERNAL COMBUSTION ENGINES

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FIG. 4.

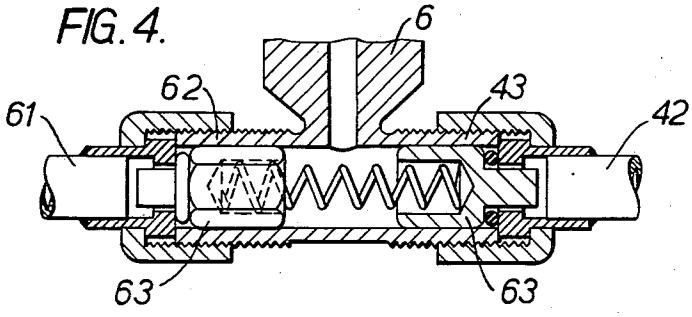
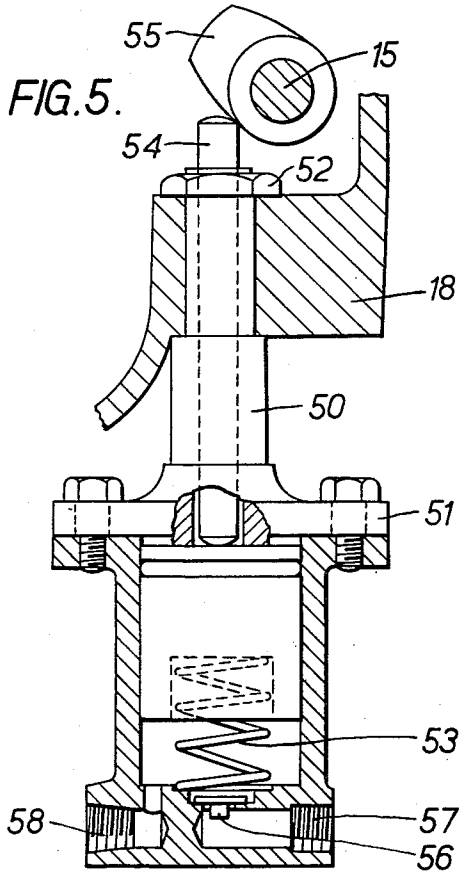


FIG. 5.



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3,068,876

APPARATUS FOR CLEANING THE NOZZLE BODIES OF THE INJECTORS OF COMPRESSION IGNITION INTERNAL COMBUSTION ENGINES

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13 Claims. (Cl. 134—95)

This invention has reference to improvements in and relating to apparatus for cleaning the nozzle bodies of the injectors of compression ignition internal combustion engines.

When nozzle bodies are made or are reconditioned certain lapping operations are performed. As a result there is a residue of abrasive which if not cleared would cause wear, seizure and damage generally. Carbon in the form of loose particles can also be present.

The principal object of the present invention is to provide efficient and quickly operable apparatus for removing the abrasive residue from new nozzle bodies, for removing the abrasive residue and any carbon particles from nozzle bodies to be reconditioned and to enable a jet or jets of cleaning liquid emerging from the spray hole or spray holes of a nozzle body to be conveniently observed that the spray hole or holes is or are clear of obstruction.

According to the invention the apparatus comprises a cleaning nozzle adapted to receive a nozzle body, means for forcing cleaning liquid through the nozzle body by way of the cleaning nozzle, means for supplying compressed air to the said cleaning nozzle so that the air passes through the nozzle body, a valve adapted to control the flow of compressed air to the cleaning nozzle and a pump adapted when operated to force the liquid through the said cleaning nozzle, and means for bringing about operation of the pump and for opening and closing of the valve.

A further object of the invention is the provision of apparatus wherein compressed air and cleaning fluid are forced in sequence through a nozzle body to be cleaned. Hence, in the case when operation of the valve precedes and succeeds pump operation, a nozzle body on the cleaning nozzle is subjected to a cleaning cycle in that it receives a blast of air which removes loose particles of unwanted matter, is then flushed by a stream of cleaning liquid and finally receives a second blast of air, which latter blast substantially clears it of cleaning liquid. The cleaning nozzle is preferably vertical with its discharge end at the top to enable the jet or jets of cleaning fluid emerging from the spray hole or holes to be easily observed.

The apparatus is preferably provided with a device adapted releasably to hold a nozzle body previously applied to the cleaning nozzle in position on the cleaning nozzle and the means above referred to adapted to bring about the operation of the valve and pump is arranged when actuated to bring the said device into operation in relation to the nozzle body prior to the commencement of the cleaning cycle and to bring the said device out of operation in relation to the said body following completion of the cleaning cycle.

The device adapted to hold a nozzle body in position on the cleaning nozzle preferably comprises two relatively spaced fingers which can be moved to and from positions where they lie at opposite sides of a nozzle body on the cleaning nozzle and located near to a shoulder on or applied to the said body.

The means adapted to bring about the operation of the valve and pump preferably comprises a shaft which is turned in one direction when a lever is depressed and is turned in the opposite direction when the lever is raised, said shaft bearing a first lobe and a second lobe, the first lobe being arranged to open and close the valve once during part of the depression of the lever and once during part of the return stroke of the ever, and the second lobe being arranged to impart a working stroke to the pump during depression of the lever following closing of the valve during the said depression.

A further object of the invention is the provision of apparatus having means for retaining a nozzle body in position on a cleaning nozzle which means permits of limited movement of the nozzle body in a direction away from the cleaning nozzle, underneath the pressure of air and cleaning liquid, in order to facilitate the cleaning of internal parts of the nozzle body by the air and liquid.

The preferred way of carrying out the invention will now be described with reference to the accompanying exemplary drawings wherein:

FIGURE 1 is a front elevation of the apparatus;

FIGURE 2 is a plan view thereof;

FIGURE 3 is a sectional elevation substantially on the line III—III, FIGURE 2;

FIGURE 4 is a sectional elevation of the lower part of a connector for joining air and liquid lines to a cleaning nozzle; and

FIGURE 5 is a sectional elevation concerned with the pump, the mounting therefor and operating means therefor.

The apparatus comprises a dished base 1 supporting a bowl 2 by means of a skirt 3 depending from the lip of the bowl resting on the lip 4 of the base. The bowl has an opening 5 in its bottom communicating with the hollow of the base, a filter screen 5*a* being arranged above the opening. The vertical stem of an inverted T-union 6 is held to the base by means of a nut 7 screwing on to the upper end of the stem; a cleaning nozzle 8 screws on to the said upper end. The nozzle 8, therefore, upstands from the base of the bowl. Behind the nozzle is a vertical rod 9 which passes through and above the bottom of the bowl and by screwing into a vertical boss 10 on the bottom of the base and receiving the screw threaded lower end of a vertical pillar 11 thrusting against the bottom of the bowl holds the bowl to the base. A dolly 12 comprising two cones on a vertical axis joined together at their wide ends by a neck portion 13 are secured to the top of the pillar 11 by a screw 14. The dolly is thus located behind the nozzle. Behind the dolly with its axis at right angles to the plane containing the axes of the dolly and cleaning nozzle is a transverse shaft 15 supported by bearings comprising posts 16 at the sides of the rear of the bowl. One end of the shaft is provided with an operating lever 17.

That part of the bowl between the posts 16 is of bar-like form, indicated by 18. Mounted in the bar 18 beneath the shaft is an air valve 19. The valve comprises a hollow stem 20 which is flanged at 21 near its lower

end and is screw threaded at its top and bottom. Within the stem is a seat 22 for a ball 23 thrust upwardly onto the seat by a spring 24; the valve outlet is indicated at 25. Around the outlet is a two way connector 26 having its bore spaced from the outer surface of the stem 20 so that air from the outlet can enter the space. The stem and connector 26 are held in position by a nut 27 at the top of the stem thrusting against the bar 18, the connector being nipped between the bottom of the bar and the top of the flange and the top and bottom of the space within the connector being made air tight by sealing rings 28. Above the ball 23 is a plunger 29 and above the plunger a ball 30. When the ball 30 is depressed the ball 23 is unseated.

Depression of the ball 30 is effected by turning the shaft 15 so that a radial lobe 31 on the shaft rides over the said ball and in so doing depresses it. The said lobe is mounted partly in a diametral hole in the shaft and partly in a hole in a collar 32 around the shaft. The extent to which the lobe projects from the collar and, therefore, the angle through which it moves whilst depressing the ball 30 can be altered by adjustment of a grub screw 33 in the said diametral hole.

A connector 34 at the bottom of the valve 19 joins an air pipe 35 to the valve; the air pipe runs from a connector 36 borne by the skirt 3. One way, 37, from the connector 26 leads to a fume aspirator tube 38 having its discharge nozzle 39 in an exhaust pipe 40. The other way, 41, is joined by a line 42 to one way 43 of the union 6. Hence, every time the valve is opened, the valve being connected at 36 to a source of compressed air, there is a surge of air through the nozzle 39 and a surge of air through the cleaning nozzle 8. Exhaust pipe 40 is connected to the apparatus by a hollow bush 44 fixed to the skirt. The bush opens to the interior of the bowl 2 by way of an opening 45 in the skirt and an opening 46 in the wall of the bowl.

Also mounted on the bar 18 beneath the shaft 15 is a pump 47 comprising a piston 48 in a vertical cylinder 49 and a hollow stem 50 upstanding from the head 51 of the cylinder. The upper part of the stem is reduced; the reduced part passes through and beyond a hole in the bar 18 and its upper end is screw threaded for a nut 52 which latter when in place holds the pump to the bar.

The pump cylinder is urged upwardly by a spring 53; it is depressed by a plunger 54 within and guided by the stem 50, the top of the plunger projecting from the top of the stem when the piston is at the top of its stroke.

Depression of the plunger and piston is effected by turning the shaft 15 anti-clockwise (FIGURE 5) so that a lobe 55 on the shaft 15 thrusts downwards against the plunger.

The pump intake, in which there is a non-return valve 56 is indicated at 57 and the outlet at 58. The intake is joined by a pipe 59 to a filter 60 in the base 1 and the outlet is joined by a liquid line 61 to the way 62 of the union 6. When the pump piston is depressed liquid is forced through the cleaning nozzle.

Ways 43 and 62 contain non-return valves 63 (FIGURE 4) so that fluid can only flow from them towards the injector. In other words air cannot enter the liquid line 61 from line 42 and liquid cannot enter the line 42 from line 61.

A bracket 64 borne by and projecting forwardly from the shaft 15 carries two forwardly projecting fingers 65 for holding a nozzle body on the cleaning nozzle 8 during a cleaning operation. The fingers which are relatively spaced laterally are pivoted at 66 (FIGURE 2) at their rear ends to the bracket 64 and are pulled towards each other by a spring 67, a stop 68 on the block limiting the nearness with which the fingers may approach each other. The median vertical plane of the space between the fingers contains the axes of the dolly and cleaning nozzle.

The relative disposition of the lobes 31 and 55 is such that when the lever 17 is depressed from a raised position (which position it may assume under the action of a spring, not shown) the lobe 31 opens and closes the valve 19 before the pump 47 is operated by the lobe 55; and the disposition of the bracket 64 in relation to the lobes, and the drive connection between the bracket and the shaft, are such that although when the lever is raised the fingers stand well clear of the cleaning nozzle, the fingers, during depression of the lever, reach their operative position in relation to a nozzle body on the cleaning nozzle before the valve 19 opens. It is necessary therefore to permit the shaft to turn after the fingers reach the said operative position. For this purpose the drive connection between the shaft 15 and the bracket 64 comprises a coil spring 69 having one of its ends in engagement with the bracket and its other end in engagement with a collar 70 pinned to the shaft 15.

A domed, transparent cover 71 rests on a ledge 72 sunk a short distance below the lip of the bowl 2. The cover is hingedly attached to the bowl by a transverse spindle 73 passing through lugs 74 at the rear of the bowl and through lugs 75 at the rear of the cover. A coil spring 76 tends to hold the cover against the said ledge 72.

The fingers 65 are shown in the drawings in their position of use; lobe 31 is shown in the position it occupies immediately after it has opened and closed the valve 19; lobe 55 is in the position it occupies in readiness to operate the pump. The fingers and lobes are brought to the said positions by partial depression of the lever 17.

When a nozzle body is to be cleaned the dished base 1 is charged with cleaning liquid, the cover 71 is raised, the body x (FIGURE 3) is applied to the cleaning nozzle 8, the cover lowered, and the lever 17, previously raised as stated hitherto by a suitably located spring (not shown) to about a vertical position is lowered so as to extend forwardly and downwardly of the apparatus. During the first part of this lowering movement the fingers 65 are splayed by the upper cone of the dolly and are then allowed to approach each other when they reach a position such that they, when so approaching, will contact with the sides of the nozzle body. Continued downward movement of the fingers with the lever proceeds until the fingers lie on opposite sides of the nozzle body near to the shoulder y on the nozzle body or, if the nozzle body is of the type without a shoulder, lie near to the shoulder on an adapter previously applied to the nozzle body. When the fingers are in the position near to the shoulder their further movement with the shaft is prevented by an adjustable stop 77 in the form of a vertical screw engaging a tapped hole in the bar 18, but the shaft can continue to turn because of the spring connection 69 between the shaft 15 and the bracket 64 bearing the fingers. Shortly after the fingers are checked the air valve 19 is opened by the lobe 31 on the shaft, with the result that a stream of compressed air is blown by way of line 42 and the connector 6 through the nozzle, thus clearing it of loose particles of abrasive or the like, is then closed, then the second lobe 55 causes the pump to force cleaning liquid by way of line 61 and the connector 6 through the nozzle body. Liquid passes to the pump from the base or receptacle 1 by way of the filter 60 and the line 59. The lever is next allowed to return or is returned by hand to the substantially vertical position with the result that as the lobe 31 re-passes the ball 30 it opens the valve, causing a second stream of air to be blown through the nozzle body and clear it of liquid, then allows the valve to close, and thereafter the fingers are raised, said fingers being splayed by the lower cone of the dolly (so that they can pass the wider end of the upper cone thereof) and allowed to approach each other as they pass the dolly. The cleaned nozzle body can be removed after the hinged cover has been raised.

It should be explained that the fingers 65 are pivotally

mounted on the bracket **64**, are spring-urged towards each other and are arranged to be splayed by the dolly **12** as described in order to enable the fingers to locate near to the shoulders on or applied to nozzle bodies of different diameters. The lower cone or wedge of the dolly prevents the fingers from snapping towards each other when they pass the thick end of the upper cone or wedge and enables the fingers to pass the thick end of said upper cone when they are returned to their out-of-the-way position in relation to the cleaning nozzle.

Liquid trapped in the cover and the bowl drains through the screen **5***a* and opening **5** in the bottom of the bowl into the base **1**. An outlet **78** closed by a removable plug **79** is provided at the front of the base for draining purposes. Compressed air and cleaner fluid fumes escape from the apparatus by way of the openings **46** and **45**, the outflow of the air and fumes being assisted by the aspirating effect of air which issues from the nozzle **39** every time the valve **19** is opened.

To enable nozzle bodies to be cleaned in the reverse direction the cleaning nozzles can be made in the form of a cup which locates on the outside of the body and allows the fingers to locate on the face of the nozzle.

The fingers **65** locate (i.e., are stopped by reason of the engagement of the bracket **64** with the stop **77**) near to the shoulder *y* of the nozzle body or near to a shoulder applied to the nozzle body by an adapter so as to oppose movement of the nozzle body in the direction in which air or cleaning fluid issuing from the cleaning nozzle tends to displace the said body, save the fingers permit a small movement of the nozzle body in the said direction.

Because the fingers permit of the above mentioned small movement of the nozzle bodies the air pressure and the liquid pressure respectively lift the nozzle body slightly and allow a space to exist between the bottom face of the nozzle body and a shoulder **80** on the cleaning nozzle. This permits the spray holes, fuel feed holes, guide bore and bottom face of the body to be cleaned.

I claim:

1. Apparatus for cleaning the nozzle bodies of the injectors of compression ignition internal combustion engines, comprising a cleaning nozzle, said cleaning nozzle being adapted to receive a nozzle body, a source of cleaning liquid, a pump for forcing the cleaning liquid through the cleaning nozzle, means for supplying compressed air to the cleaning nozzle, a valve for controlling the flow of compressed air to the cleaning nozzle, means for bringing about operation of the pump and for opening and closing the valve, means for holding a nozzle body on said cleaning nozzle, said holding means opposing movement of the nozzle body under the thrust of fluid issuing from said cleaning nozzle, means for moving said holding means into and out of holding position in relation to said nozzle body, and a drive coupling between said holding means and said means for bringing about operation of the pump and opening and closing of the valve, said last named means being adapted when actuated to bring said holding means into use in relation to a nozzle body prior to bringing about operation of said pump and opening and closing of said valve.

2. Apparatus for cleaning the nozzle bodies of the injectors of compression ignition internal combustion engines, comprising a cleaning nozzle, said cleaning nozzle being adapted to receive a nozzle body, a source of cleaning liquid, a pump for forcing the cleaning liquid through the cleaning nozzle, means for supplying compressed air to the cleaning nozzle, a valve for controlling the flow of compressed air to the cleaning nozzle and means for bringing about operation of the pump and for opening and closing the valve, said last-mentioned means comprising a shaft, a lever for turning the shaft in one direction and for turning the shaft in the opposite direction, a first lobe on said shaft and a second lobe on said shaft, said first lobe being adapted to open and close said valve once when said shaft is turned in said one direction and to open and close said valve when said shaft is turned in the opposite direction and said second lobe being adapted to impart a working stroke to said pump following closing of said valve whilst said shaft is turned in said one direction.

3. Apparatus according to claim 1, wherein said holding device comprises two relatively spaced fingers, a mounting turnably supporting said fingers whereby said fingers can be turned to and from positions where they lie at opposite sides of said cleaning nozzle, and a stop, said stop preventing movement of said fingers beyond a predetermined point in relation to said cleaning nozzle.

4. Apparatus according to claim 3, wherein said stop is adjustable.

5. Apparatus according to claim 2 comprising two relatively spaced fingers, means mounting said fingers on said shaft, said fingers extending laterally from said shaft, a drive coupling between said mounting means and said fingers whereby said fingers turn with said shaft, said cleaning nozzle being located in the path of movement of said fingers when said shaft is turned in said one direction, a stop, said stop preventing movement of said fingers beyond a predetermined point in relation to said cleaning nozzle, said drive connection being adapted to allow said shaft to turn through a further angle in said one direction after said fingers have been checked by said stop, said first lobe and said second lobe being adapted to open and close said valve and to bring about operation of said pump respectively during turning of said shaft in said one direction in said further angle and said first lobe being adapted to open and close said valve during opposite movement of said shaft in said further angle.

6. Apparatus according to claim 1 wherein said holding device comprises two relatively spaced fingers, a mounting, said mounting turnably supporting said fingers whereby said fingers can be turned to and from positions where they lie at opposite sides of said cleaning nozzle, pivots pivotally mounting said fingers on said mounting whereby said fingers can splay relatively, a spring urging said fingers towards each other, in combination with means for splaying said fingers, said means being adapted to splay said fingers as they approach their positions at the sides of said cleaning nozzle.

7. Apparatus according to claim 6 wherein said means for splaying said fingers comprises a wedge, said wedge being positioned to enter the space between said fingers as said fingers approach said positions.

8. Apparatus according to claim 6 wherein said means for splaying said fingers comprises a first wedge, said first wedge being positioned to enter the space between said fingers as said fingers approach said positions, in combination with a second wedge, said second wedge having its wide end joined to said first wedge, said second wedge being adapted to splay said fingers when said fingers move from said positions at the sides of said cleaning nozzle.

9. Apparatus according to claim 8, comprising a neck portion between said first wedge and said second wedge.

10. Apparatus according to claim 2, comprising a dished base, a bowl above the base, said bowl having a draining opening, said draining opening communicating with the interior of said dished base, said cleaning nozzle upstanding from the bottom of said bowl, bearings on the bowl rearwardly of said cleaning nozzle, the axis of said bearings being horizontal, said bearings supporting said shaft, one end of said shaft projecting from said bearings, an operating lever, said operating lever being secured to said end, said air valve and said pump being located beneath said shaft.

11. Apparatus according to claim 10, comprising a vertical screw-threaded rod, said rod securing said bowl to said base.

12. Apparatus according to claim 10, comprising a domed cover, a hinge securing said cover to said bowl,

and a transparency in said cover, said transparency exposing said cleaning nozzle.

13. Apparatus for cleaning the nozzle bodies of the injectors of compression ignition internal combustion engines, comprising a cleaning nozzle adapted to receive a nozzle body, a source of cleaning liquid, a pump for forcing the cleaning liquid through the cleaning nozzle, means for supplying compressed air to the cleaning nozzle, a valve for controlling the flow of compressed air to the cleaning nozzle, means for bringing about operation of the pump and for opening and closing the valve, a first nonreturn valve and a second nonreturn valve, said nonreturn valves being located in the vicinity of the inflow passage of said cleaning nozzle and their flow direction being towards said cleaning nozzle, an air line, said air line connecting said first nonreturn valve to said valve for controlling the flow of compressed air to said cleaning nozzle, and a liquid line, said liquid line connecting said second nonreturn valve to said pump.

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